Aura Data System Working Group
Meeting Fall 2006

# Aura Microwave Limb Sounder

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Boulder, Colorado
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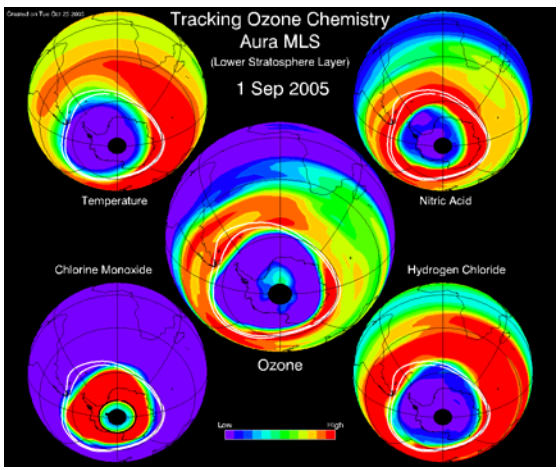
# Outline




- Major Milestones
- Instrument Status
- SIPS Status
- Science Data Products
- Level 2 Processing Status
- Testing for Evolution
- Version 2 Development Status
- MLS Data flow
- MLS Data Products for Version 2
- Aids to Users
- Libraries and Compilers
- Performances of PGEs
- Summary
- Useful Web Pages

# Major Milestones

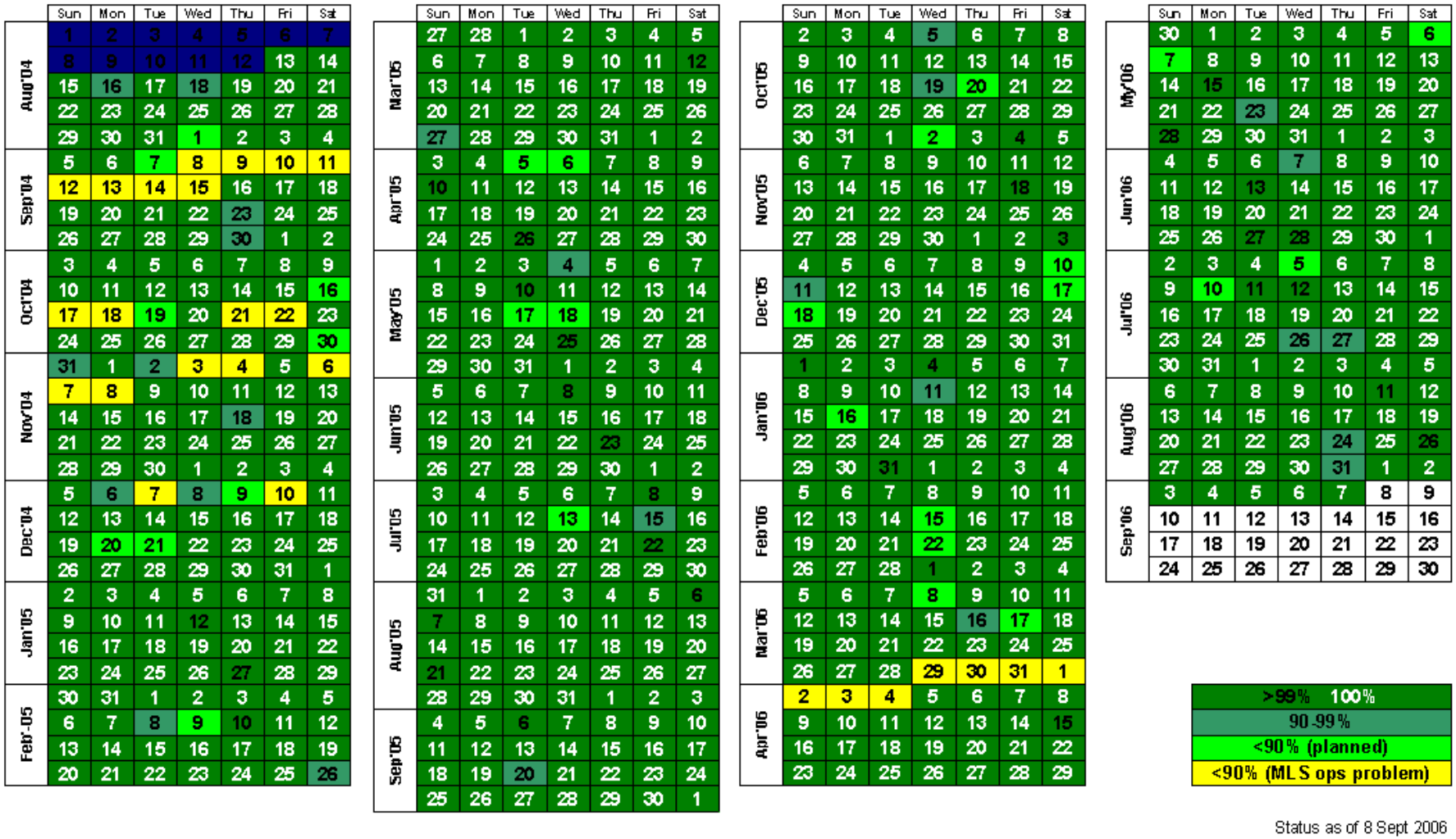
- Major MLS milestones since launch (15 July 2005)
  - Full-up science observations start . . . . . 13 August 2004
  - V1.51 (first public release) data processing starts . . . . . 28 January 2005
  - V1.51 data accessible on GES DISC, starting . . . . . 15 February 2005
  - Released MLS V1.51 Data Quality Documents . . . . . 1 August 2005
  - All backlog processing completed for V1.51 . . . . . 25 October 2005
  - Aura Science Meeting, The Hague, Netherlands . . . . . 8 November 2005
  - V1.52 of Level 2 PGE (no Band 13 data) . . . . . March 2006
  - Release 0 of Version 2 PGEs . . . . . June 2006
  - Achieved Mission Success Criteria . . . . . 13 August 2006
  - Release 1 of Version 2 PGEs . . . . . August 2006
  - Aura Science Meeting, Boulder, Colorado . . . . . 11-15 September 2006
  - Release 2 of Version 2 PGEs . . . . . November 2006
  - Begin production with Version 2 (planned) . . . . . November 2006
  - Release MLS V2 Data Quality Document . . . . . December 2006

## MLS Instrument continues nominal operations

- The MLS Instrument Operations Team (IOT) continues to conduct routine and special instrument operational activities from the Instrument Support Terminal at JPL
- Nominal operations includes a monthly Antenna Actuator Assembly lubricant redistribution sweep (AAA reconditioning)
- Three major problems have occurred in the last year:
  - Band 13 (HCl measurements) shows accelerated degradation and is planned for only monthly measurements (February 2006)
  - Entered an unexpected cascading event that shut down some of the instrument (loss of 8 days of measurement – 29 Mar-4 Apr, 2006)
  - Bands 10 (ClO) and 29 (HOCl) exhibited anomalous behavior and were shutdown from Apr 18-May 18
    - Their behavior shows dependency on temperature variations within the radiometer, that includes orbital variation and Band 13, therefore Band 13 measurements are on hold for the indefinite future
- Since start of science operations on 13 August 2004, 94.6% of all possible measurements have resulted in science measurements
  - 28 days with less than 90% good measurements due to planned non-science activities in support of calibration activities, HIRDLS pitch manuevers, and other activities
  - 26 days with major outages due to MLS problems

# *Aura Microwave Limb Sounder*

## Instrument Calendar



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| Aug'04 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
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| Dec'04 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
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| Jan'05 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
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| | 29 | 30 | 31 | 1 | 2 | 3 | 4 |
| Jun'05 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
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| Jul'05 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
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| Aug'05 | 31 | 1 | 2 | 3 | 4 | 5 | 6 |
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| Feb'06 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
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| Mar'06 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
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| | 26 | 27 | 28 | 29 | 30 | 31 | 1 |
| Apr'06 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
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| | 28 | 29 | 30 | 31 | 1 | 2 | 3 |
| Jun'06 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
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| | 25 | 26 | 27 | 28 | 29 | 30 | 1 |
| Jul'06 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
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| | 30 | 31 | 1 | 2 | 3 | 4 | 5 |
| Aug'06 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
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| Sep'06 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
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| | 24 | 25 | 26 | 27 | 28 | 29 | 30 |

| |
|---|
| >99% 100% |
| 90-99% |
| <90% (planned) |
| <90% (MLS ops problem) |

Status as of 8 Sept 2006

# Science Processing/SIPS

## SIPS continues routine data production

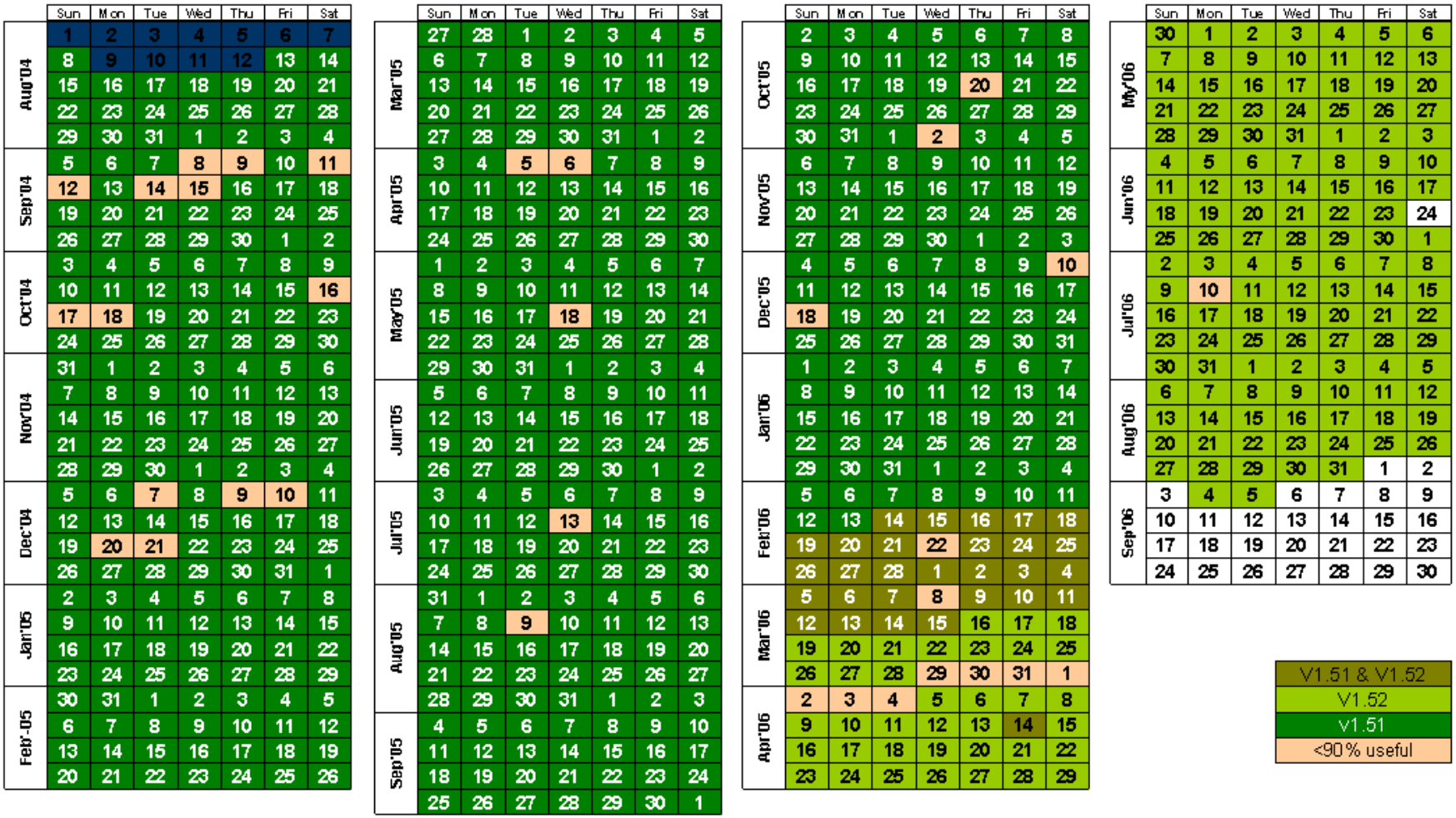
- Running v1.5.2 of SIPS in operations
  - Although we are funded for 8/5 staffing, SIPS has been very successful in a 24/7 operations – excellent team at Raytheon, Pasadena shared with TES
  - Data flow from GES-DAAC has been mostly consistent and timely
  - Issues worked via email, phone calls, and biweekly telecons between SIPS and GES-DAAC in a timely manner - GES-DAAC has been very responsive
- Level 1 processing is active with v1.51 and v2.11
  - Processing MLS Level 0 data to Level 1 on a daily basis as data arrives
  - Limited data from v2.11
- Level 2 processing is active with v1.51, v1.52, and v2.1
  - If Band 13 is active, also process with v1.51
  - Limited data from v2.1
- Level 3 processing will become active with V2.2
- Data delivery to SCF is active
- Data delivery to GES-DISC is active
- Producing copies of critical subset of the data on DVD for SCF
  - Stopped sending data to University of Edinburgh (co-PI) at their request

# Science Data Products

## Science team inspects all science products and reviews them at the weekly science team meetings

- Routine archiving of Level 1b and Level 2 products at GES-DISC
  - Began in February'05 with PGEs v1.51
  - Quality Document released August'05 and data became public
  - All but 5 days processed to Level 1b since beginning of science operations
  - All but 33 days processed to Level 2 since beginning of science operations
  - 29 days processed by both V1.51 and V1.52 to Level 2
    - V1.52 was necessary to process data without Band 13
- Because of institutional and location convenience, MLS shares its data holdings with TES scientists at JPL
  - Does not use GRID technology (poster by Brian Knosp in session 2)

# Level 2 Processing Status




Status as of 8 Sept 2006

# Testing for *Evolution*

## MLS SCF and SIPS continue to support testing for *Evolution*

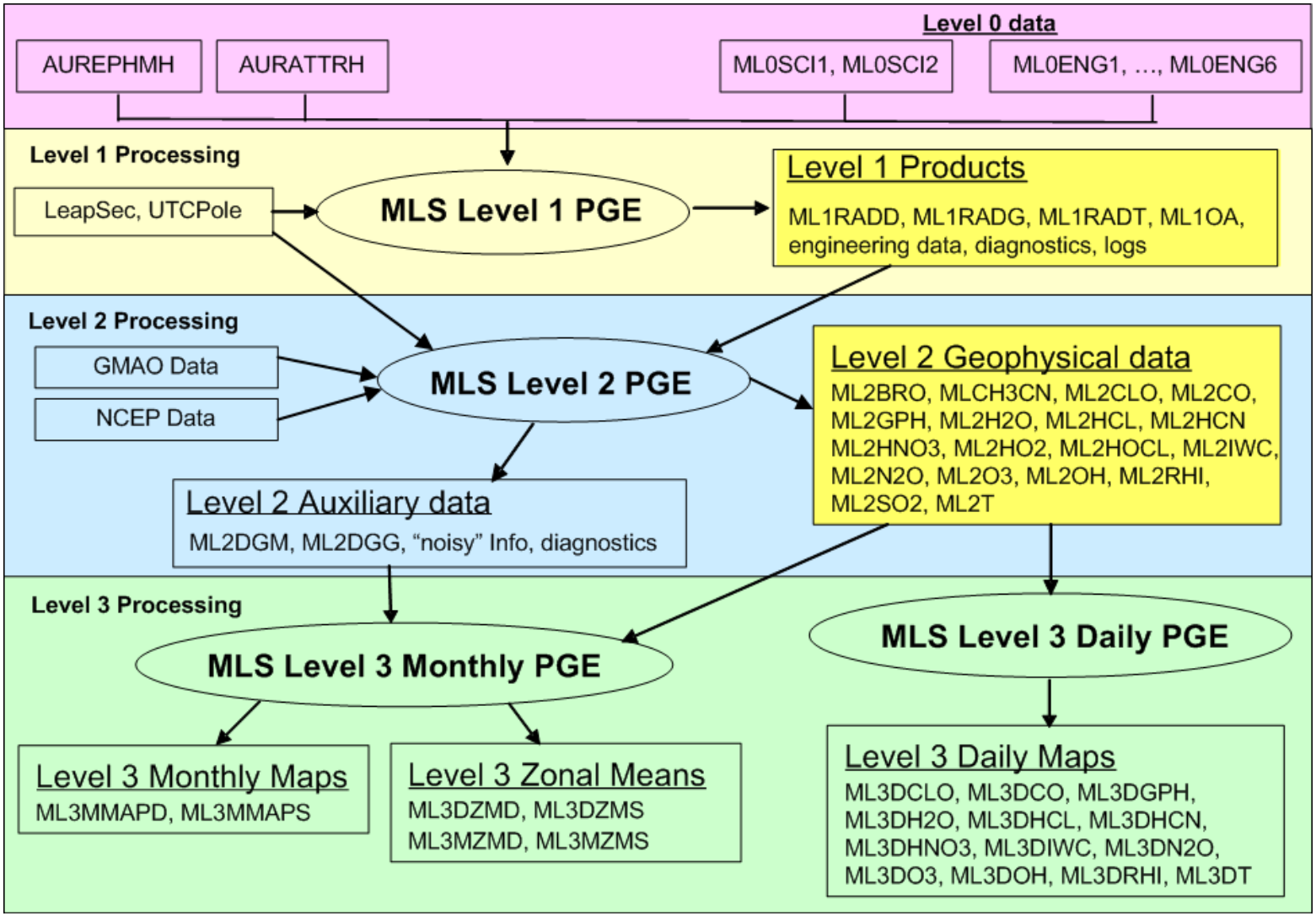
- Mini-MOSS for GEOS-5 data flow from GOLDS tested 8x data flow to SIPS and SCF – no issues
  - Concern with data volume especially during the retro-processing period
- Providing support of informal tests for
  - EDS (Level 0) from GES-DISC to SCF
  - PDS (Level 0) from GES-DISC to SIPS
  - Level 1 from SIPS to GES-DISC
  - Level 2 from SIPS to GES-DISC
- Future:
  - Level 3 from SIPS to GES-DISC

# Version 2

## Status of progress on Version 2 of PGEs

- Features of Version 2
  - Level 1b and Level 2 products will be improved from V1.5
  - Add Level 3 products in this release
  - Plan to add two new data types at Level 2
    - $CH_3CN$ (Methyl Cyanide)
    - $SO_2$ (Sulfur Dioxide) – already have the data types, but no products
  - Increment ESDT version (=2) for all data sets
  - Use *h5repack* to optimize output products
    - Compression is set to GZIP = 1
- Release 0 (V2.0) was dress rehearsal – Jun'06
- Release 1 (V2.1) is preliminary release – Aug'06
  - Limited set of products available at AVDC
  - Uses GEOS-4 as input
- Release 2 (V2.2) is the final release – Nov'06
  - Products will be the basis for the validation papers due in Mar'07
  - GEOS-5 is a required input; GEOS-4 is not a valid input

# Data Flow Diagram



# Science Data Products

## Level 1B and Level 2 Products for Version 2

| Short Name | Geophysical Parameter | | Short Name | Geophysical Parameter |
|---|---|---|---|---|
| ML1RADD | L1 Radiances from DACS | | ML1RADT | L1 Radiances from THz |
| ML1RADG | L1 Radiances from GHz | | ML1BOA | L1 Orbit and Attitude |
| ML2BRO | L2 Bromine Monoxide | | ML2HOCL | L2 Hypochlorous Acid |
| ML2CLO | L2 Chlorine Monoxide | | ML2IWC | L2 Ice Water Content |
| ML2CO | L2 Carbon Monoxide | | ML2N2O | L2 Nitrous Oxide |
| ML2CH3CN | L2 Methyl Cyanide | | ML2O3 | L2 Ozone |
| ML2GPH | L2 Geopotential Height | | ML2OH | L2 Hydroxyl |
| ML2H2O | L2 Water Vapor | | ML2RHI | L2 Relative Humidity w/ ice |
| ML2HCL | L2 Hydrogen Chloride | | ML2SO2 | L2 Sulfur Dioxide |
| ML2HCN | L2 Hydrogen Cyanide | | ML2T | L2 Temperature |
| ML2HNO3 | L2 Nitric Acid | | ML2DGG | L2 Diagnostic, GP Grid |
| ML2HO2 | L2 Hydroperoxy | | ML2DGM | L2 Diagnostic, Misc. Grid |

# Science Data Products – continued

## Level 3 Products for Version 2

| Short Name | Geophysical Parameter | | Short Name | Geophysical Parameter |
|---|---|---|---|---|
| ML3DZMS | L3 Daily Zonal Mean, Standard | | ML3DZMD | L3 Daily Zonal Mean, Diagnostics |
| ML3MZMS | L3 Monthly Zonal Mean, Standard | | ML3MZMD | L3 Monthly Zonal Mean, Diagnostics |
| ML3MMAPS | L3 Monthly Maps, Standard | | ML3MMAPD | L3 Monthly Map, Diagnostics |
| ML3CLO | L3 Daily Map, Chlorine Monoxide | | ML3IWC | L3 Daily Map, Ice Water Content |
| ML3CO | L3 Daily Map, Carbon Monoxide | | ML3N2O | L3 Daily Map, Nitrous Oxide |
| ML3GPH | L3 Daily Map, Geopotential Height | | ML3DO3 | L3 Daily Map, Ozone |
| ML3H2O | L3 Daily Map, Water Vapor | | ML3DOH | L3 Daily Map, Hydroxyl |
| ML3HCL | L3 Daily Map, Hydrogen Chloride | | ML3DRHI | L3 Daily Map, Relative Humidity w/ ice |
| ML3HCN | L3 Daily Map, Hydrogen Cyanide | | ML3DT | L3 Daily Map, Temperature |
| ML3HNO3 | L3 Daily Map, Nitric Acid | | | |

# Aids to Users

Help is available to user in many ways in addition to those available through GES-DISC

- MLS home page provides useful information and links to others
  - http://mls.jpl.nasa.gov/
  - See poster by Brian Knosp
- MLS provides Data Quality Document
  - Available through the main MLS web page
- MLS provides user registration
  - Provides updates to instrument and processing status
- Users can ask for help via email: data@mls.jpl.nasa.gov
- MLS provides an IDL reader for the Level 2 products through Open Channel Software that distributes software for Caltech/JPL
  - http://www.openchannelsoftware.org/projects/Read_MLS_Level_2_Geophysical_P/
  - Level 3 readers will be coming soon

# Libraries and Compilers

- Library versions in used by MLS V1.5
  - HDF4: 4.2r0
  - HDF5: 1.6.2
  - Toolkit: 5.2.12
  - HDF-EOS 2.12
  - HDF-EOS5 5.1.8
- Library versions in used by MLS V2.1
  - HDF4 4.2r1(a)
  - HDF5 1.6.5-post5
  - Toolkit 5.2.14
  - HDF-EOS 2.14
  - HDF-EOS5 5.1.10
- Our compilers:
  - gcc 3.4.6
  - NAG f95 5.0
  - Lahey lf95 6.10e

# Performance of PGEs

## Performance of PGEs is within limits of resources

- Level 1:
  - V1.51 requires less than 6 CPU hours for each data day
  - V2.x will require less than 6 CPU hours for each data data
- Level 2
  - V1.51 requires about 7000 CPU hours for each data day
  - V1.52 requires about 5900 CPU hours for each data day
  - V2.1 requires about 11,200 CPU hours for each data day
    - Hope to lower this with V2.2
    - Use of queue management will use most of available CPU hours
    - Each cluster will provide a maximum of 8736 CPU hours
      - 3 clusters available, each running 364x3.06 GHz Pentium Xeon processors
    - Timeliness attained by dividing a day of data into 350 chunks and running the chunks in parallel on 350 processors
- Level 3
  - V2.x Daily Map will require less than 6 CPU hours for each 10 day run
  - V2.x Monthly run will require less than 6 CPU hours

# Summary

- Status Summary
  - MLS instrument continues to work well, despite several problems
  - MLS data processing systems operating smoothly
  - Plans are well underway for Version 2 although there are challenges
  - All Level 1B and Level 2 products routinely archived & available from GES DISC

# Useful Web Pages

- Microwave Limb Sounder home page
  - http://mls.jpl.nasa.gov/
- IDL Reader for Level 2 products
  - http://www.openchannelsoftware.org/projects/Read_MLS_Level_2_Geophysical_P/
- Aura Guidelines
  - http://www.eos.ucar.edu/hirdls/HDFEOS_Aura_File_Format_Guidelines.pdf
- EOS Data Gateway (EDG)
  - http://delenn.gsfc.nasa.gov/~imswww/pub/imswelcome/
- GES DISC Web-based Hierarchical Ordering Mechanism (WHOM)
  - http://disc.gsfc.nasa.gov/data/dataset/MLS/
- GES DISC Datapool
  - http://disc.gsfc.nasa.gov/data/datapool/MLS/
- GES-DISC Interactive Online Visualization and Analysis Infrastructure (Giovanni)
  - http://reason.gsfc.nasa.gov/Giovanni_mls3d/